

Project-Based Learning: Teachers' Perception & Learners' Preparedness

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Abstract: Earlier at the ICRES 2022 we discussed readiness of teachers of the Chemistry Faculty of the Karaganda Buketov University for the student-centered learning approach lately implemented at the Kazakhstani universities. In particular, we studied the progress made by academic staff in mastering interactive lecturing, case-study, problem-based learning etc. In this study we focus on project-based learning (PBL) and reveal teachers' perceptions regarding the method benefits and challenges as well as preparedness for learning by doing from students' perspective. Academic staff of four Departments as well as students and Master students admitted in such educational programs as "Chemistry", "Chemistry-Biology" and "Pharmaceutical Manufacturing Engineering" were involved in our study. These educational programs train both future teachers and technologists. It was crucial to analyze how both undergraduates and postgraduates of different training programs evaluate the project method efficiency in mastering knowledge in chemical disciplines. Surveys of educators and learners were conducted. The collected data was processed and analyzed. The research results show that the academic staff and learners of the Faculty of Chemistry understand PBL from both positive and negative perspectives. The findings can be beneficial for teachers and students, as they will help them to reflect on their own practice in this educational strategy. There has been demonstrated the need for further research in this direction to better understand teachers' and learners' demands in order to improve the method application at the universities in Kazakhstan.

Keywords: Project-Based Learning, Benefits, Challenges, Teachers, Learners

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Introduction

New challenges in education require teachers to use new ways of learning and teaching. Universities in Kazakhstan replace traditional academic strategies of passive learning by student-centered learning. Our previous research focused on the teachers' methodological readiness for student-centered learning and challenges associated with its implementation (Minayeva Ye. et al., 2022). We also discussed the effectiveness of the student-centered learning approach for students' achievement in universities in Kazakhstan (Sugralina L. et al., 2017).

Project-based learning (PBL) is known as an effective student-centered learning method with the variety of benefits for students despite some difficulties for learners and challenges for educators. PBL is a teaching method that is engaging and motivating (Bell, 2010). It is a learner-driven, customized, and collaborative learning system that leads to transformational learning. Implementation of PBL has contributed to increases in students' retention of concepts, engagement, and academic success (Harrigan, 2014). PBL has the ability to enhance students' learning (Jones, 2007), engage students on a deeper cognitive level than traditional teaching methods. For some teachers and students, PBL is more effective than traditional teaching methods because different learning styles or multiple intelligences are intertwined in the learning strategy (Filippatou & Kaldi, 2010).

There are several positive reasons for integrating PBL in the practical classes. However, researchers have found that some teachers are reluctant to integrate PBL into the classroom. Major challenges for using PBL are time, effort, fairness, assessment, lack of resources, and control (Wirkala & Kuhn, 2011). Some educators find becoming a facilitator a challenge. They feel uncomfortable or even resist letting go of their control (Mitchell et al., 2009). To date, such disputes on PBL have been based mostly on international experience, and there is a lack of research discussing the situation at Kazakhstani universities. It remains unclear how teachers in Kazakhstan implement PBL, and what benefits and challenges of using PBL they identify. At the same time, it is necessary to investigate students' preparedness for learning by doing. Therefore, this study attempts to fill the research gap about the application of PBL in Kazakhstan. This paper aims to reveal the perception of teachers of the Chemistry Faculty of the Karaganda Buketov University towards the PBL approach and discuss students' preparedness to it.

Method

This is case study research that was conducted to determine faculty perceptions regarding the implementation of PBL, as well as students' readiness to learn in practice. The setting of the study is the Chemistry Faculty of the Karaganta Buketov University. In order to determine teachers' perceptions regarding problems and benefits of PBL implementation, we conducted a survey of the Chemistry Faculty teaching staff in 2022-2023 academic year. We developed our own questionnaire in two training languages, which included 11 closed and open-ended questions. A total of 31 teachers that was 52% of academic staff took part in the survey. A questionnaire for students and master students included 9 questions. A total of 93 students and master students of the Chemistry Faculty took part in the survey. Questionnaires of the teaching staff, students and master students were subjected to subsequent analysis of the data obtained.

Results

Information about respondents among teachers

Most of the respondents among teachers, namely 91% have an academic degree. Teachers with teaching experience from 15 to 19 years comprised the largest number of respondents, namely 26%. Representatives of all four departments of the Chemistry Faculty took part in the survey. Teachers of the Department of Organic Chemistry and Polymers were the most active ones (15 persons or 48 %). At the same time, teachers in the position of associate professor showed the greatest activity.

Teachers' proficiency in PBL

According to the survey results, 77% of academic staff consider themselves PBL proficient and 7% are unsure of their PBL proficiency. At the same time, 16% of respondents among teachers had difficulty answering this question. As regards the periodicity of using PBL in the teaching process, a total of 13 % of academic staff apply this approach consistently, whereas a total of 13% do not apply it in the instructional process. The majority of teachers, namely 74% of respondents use PBL occasionally.

Self-Evaluation of methodological preparedness for PBL practical implementation

In order to assess the methodological readiness of teachers to implement PBL in practice, chemistry faculty members were asked to rate it on a 0-5 scale. The results are summarized in Table 1.

Table 1. Self-Evaluation of methodological preparedness for the PBL practical implementation

Evaluation from 0 to 5-point scale	Percentage, %
0	3
1	0

2	6
3	39
4	29
5	23

As can be seen from the table a total of 23% of respondents confidently implement PBL.

The main incentive for teachers to use PBL in teaching/learning process

Among the significant incentives for using PBL in the instructional process, educators cited a desire to increase students' mental alertness and creativity. Other important incentives for using PBL in the teaching/learning process are listed in Table 2.

Table 2. The main incentives for using PBL in the educational process

Incentive	Number of respondents, persons	Percentage, %
Desire to enhance the students' mental activity and creative potential	25	81
Desire to comply with modern trends in education	10	32
Need for continuous improvement of students training	9	29
Need for a successful open session	4	13

Benefits in the application of PBL in the teachers' practice

In order to discuss the benefits of using PBL in faculty practice, academic staff were asked to highlight a number of benefits of the PBL approach. Faculty responses are shown in Table 3. Respondents could select several options in the response box.

Table 3. Benefits in the application of PBL in the teachers' practice

Benefits	Number of respondents, persons	Percentage, %
Achieving a better understanding by students of what they are doing and why	20	64
Development of critical thinking and creativity in students	16	52
Achieving greater student activity in acquiring knowledge and skills	12	39
Continuous professional development of academic staff	6	19

Problems which teachers face when implementing a PBL approach

Teachers were also asked to describe problems encountered when implementing PBL in teaching. Teachers' responses are summarized in Table 4. They were able to select several options.

Table 4. Problems which teachers face when implementing a PBL approach

Problems	Number of respondents, persons	Percentage, %
Students' unwillingness to take responsibility for managing projects; activities in the classroom and outside the classroom	18	58
Uneven assimilation of knowledge by students	15	48
Preparing for classes requires more teachers' time	10	32
Difficulty in assessing students' academic achievements	5	16
Noise in the classroom and chaotic organization of the learning space	2	6

Ways to solve problems arising from the implementation of PBL

To overcome problems associated with the PBL approach implementation, teachers suggested several ideas which are given in Table 5. Teachers could choose several options from the list.

Table 5. Ways to solve problems arising from the PBL implementation

Ways to overcome problems associated with PBL	Number of respondents, persons	Percentage, %
Phased implementation of PBL	13	42
Informing students about the ideas behind PBL	11	35
Methodological assistance to teachers for the implementation of educational innovations from the Faculty and the University	11	35
Application of various forms of stimulating students to independent learning activities	10	32
Giving students enough time to learn at their own pace and empowering learners as mentors to peers	10	32
Comprehensive support for the best experience in teaching for implementation of PBL approaches	6	19

Information about students

Most of the respondents among students, namely 91% were undergraduate students and 9% were master students. Representatives of first, second, third and fourth year of study took part in the survey. Students of the second and third year of study were the most active. At the same time, undergraduate students and graduate students admitted in such educational programs as “Chemistry”, “Chemistry-Biology” and “Pharmaceutical Manufacturing Engineering” were involved in our study. These educational programs train both future teachers and technologists.

Practical experience of students in PBL

In this part of the survey, students were asked if they were familiar with PBL. The vast majority of learners (54%) responded that they knew what the PBL approach was, while 34% of respondents were unaware of the method. In addition, students were asked if they had any experience with assignments in the form of project work. A total of 52% of students had completed assignments in the form of a project, while 40% had not.

Evaluation of PBL effectiveness by students

Students were asked to rate on a 5-point scale how effective their learning was with the PBL approach. The results are shown in Table 6.

Table 6. Evaluation of PBL effectiveness by students

Evaluation from 0 to 5 point scale	Percentage, %
0	16
1	1
2	7
3	14
4	26
5	36

Self-assessment of student readiness for PBL

Students were asked to self-assess their readiness for PBL assignments on a scale of 0-5 points. The results are presented in Table 7.

Table 7. Self-assessment of students' readiness for PBL assignments

Evaluation from 0 to 5 point scale	Percentage, %
0	18

1	4
2	4
3	20
4	16
5	38

Self-assessment of student interest in doing PBL

In this part of the survey, students were asked to rate on a five-point scale their interest in completing project assignments in the future. The students' responses are shown in Table 8.

Table 8. Self-assessment of student interest in PBL assignments

Evaluation from 0 to 5 point scale	Percentage, %
0	8
1	0
2	4
3	22
4	22
5	44

Problems students encountered when completing PBL assignments

Students were also asked to discuss problems they had encountered with PBL assignments. When answering this question, students could select several options in the answer box. The results are given in Table 9.

Table 9. Problems students encountered when completing PBL assignments

Problems	Number of respondents, persons	Percentage, %
You had to study a large amount of additional scientific and educational literature	44	47
It took you a long time to prepare	40	43
You have had difficulty interacting with other team members	20	21
Lack of incentives for independent learning activities	15	16
An increased level of responsibility in carrying out independent work in the form of a project	8	9

Discussion

To begin, we wanted to find out how well teachers of the Chemistry Faculty are familiar with the PBL approach and how often they apply it in their teaching practice. According to the survey results, most of the teachers surveyed, namely 77% consider themselves to be proficient in PBL, while 7% were not confident about their proficiency in PBL. At the same time, 16% of educators had difficulty answering this question. Regarding the frequency with which project-based learning is used in the classroom, 13% of educators use the approach all the time, while 74% of respondents use it occasionally. A total of 13% of teachers do not use this approach in the teaching process at all.

At the same time, 23% of teachers evaluated their methodological preparedness for the maximum score on a 5-point system, while 39% of teachers, a majority, rated their readiness as a 3-point score. One respondent (3%) of the academic staff stated a complete lack of practical skills in PBL. In addition, among the most important incentives for the PBL approach implementation in the educational process, teachers named the desire to enhance the students' mental activity and creative potential as well as desire to comply with modern trends in education.

In order to explore the attitudes of teachers of the Chemistry Faculty to the PBL approach, we asked them to highlight a number of benefits and discuss problems associated with the PBL implementation into the teaching/learning process. Teachers mentioned the following benefits of a PBL approach:

- Achieving a better understanding by students of what they are doing and why – 20 respondents (65%);
- Development of critical thinking and creativity in students – 16 respondents (51%);
- Achieving greater student activity in acquiring knowledge and skills – 12 respondents (39%).

As regards problems which teachers face when implementing a PBL approach, it is worth to mention the following ones:

- Students' unwillingness to take responsibility for managing projects; activities in the classroom and outside the classroom - 18 respondents (58%);
- Uneven assimilation of knowledge by students - 15 persons (48%);
- Preparing for classes requires more teachers' time – 10 respondents (32%).

To overcome problems associated with the PBL approach implementation, teachers suggested phased implementation of PBL, informing students about the ideas behind PBL, as well as methodological assistance to teachers for the implementation of educational innovations from the Faculty and the University.

Turning to undergraduate and graduate students surveyed, the majority of students (54%) responded that they were familiar with the PBL approach, while 34% of respondents knew nothing about the method. In addition, undergraduate and graduate students were asked if they had any experience with assignments in the form of

project work. A total of 52% of students had completed assignments in the form of a project, while 40% of students had not. These results indicate that the Academic Council of the Chemistry Faculty should look at how to promote the PBL approach in the department and engage students in project-based activities.

Students also assessed how effective their learning was with the PBL approach. The results showed that 36% of respondents considered PBL to be a very effective method, while 16% of students surveyed considered the method ineffective. Students were asked to rate their readiness to perform PBL assignments on a 0-5 scale. A complete lack of practical PBL skills was reported by 18% of the students surveyed, while 38% of respondents were prepared to complete PBL assignments. Students rated on a 5-point scale their interest in completing project assignments in the future. It appeared that 40 students (44%) were confidently interested in doing PBL work in the future, while 7 respondents (8%) stated a complete lack of interest in PBL.

Students also noted that they encountered a number of problems while completing PBL assignments. Learners noted that they had to study a lot of additional scientific and scholarly literature; they needed a lot of time to prepare; and they had difficulty interacting with other team members. Looking for recommendations to improve the practice of the PBL approach in the department, students suggested improving the material conditions for practical assignments in the project method and finding more topics for project work. Surprisingly, the students surveyed chose to work on projects independently rather than in teams.

The results were discussed at the Academic Council of the Faculty of Chemistry. A number of recommendations were developed to improve the practice of using PBL at the Faculty of Chemistry. The obtained results can be useful for teachers and students, as they will help them to think about their own practice of applying this educational strategy. As a result of the case study research, the need for further investigation in this direction was identified in order to better understand the needs of teachers and students and to promote the application of the method in universities in Kazakhstan.

Conclusion

A total of 77% of the surveyed academic staff of the Chemistry Faculty are confident in PBL, although 74% of teachers use the approach occasionally in their teaching. Only 13% of respondent teachers use this method consistently in their teaching, and 13% of teachers do not use it at all. A total of 38% of students are confidently prepared to do PBL work. A complete lack of practical skills in PBL was reported by 18% of students. PBL is considered an effective tool because it provides students with the opportunity to learn through project activities, although this approach is time-consuming for both teachers and students. Problems with group work and cases of unequal contributions to the course of group work are also mentioned. Reported benefits include: increased engagement and motivation to learn, skill development, collaborative learning environment, and improved academic performance. Students also find PBL to be a method that promotes a better understanding of course content through a hands-on approach. It is important that students enjoy the class and are engaged in the

learning process. The findings can be beneficial for teachers and students, as they will help them to reflect on their own practice in PBL.

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